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Federated Research Profile Management in Indian Institute of Technology (IIT) in the Context of Indian Research Information Network System (IRINS)

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Abstract
Tracking the visibility of research activities towards evaluating research projects and outcomes with means become an important component of Indian Research Information Network System (IRINS) in the context of institutions. The present study is based on empirical analysis of twenty-three (23) Indian Institute of Technologies (IITs) of India in the context of IRINS to explore the number of faculties, highest scholarly publications with Scopus and CrossRef citations, departments, and faculty's publications of IITs. The analysis observed that the implementation of IRINS depends on the level of success and user acceptance. It has been revealed that the institutional and technological factors are affecting the successfully implementation of IRINS in IITs of India.

Keywords IIT, IRINS, RIM, INFLIBNET, SCOPUS, DOI

Introduction

As on date, twenty-three (23) Indian Institute of Technology (IIT) have been established by the Act of Parliament of India and declared as Institution of National Importance to be Centers of Excellence for training, research and development in science & technology and engineering in India. Over the years, IITs have been created world class educational platforms dynamically sustained through internationally recognized research based on state-of-the-art infrastructural facilities. The faculty and alumni of IITs have made a huge impact in all the sectors of society at national and international level. The IITs are globally recognized as the centers of academic excellence.

The IITs are striving for their prominence by showcasing their research presence in respect to various key parameters across the national and international benchmarking and ranking frameworks. At all levels need to regularly update about their on-going research in their respective subject expertise. The Information on research interest and research output of faculties in terms of publications, citations and other intellectual output has been highly scattered. To ease and facilitate the flow of information on research carried out, the Indian Research Information Network System (IRINS) serving as common platform to project performance of the IITs, departments and individual faculty on various Bibliometrics Parameters.

The Indian Research Information Network System (IRINS) a web-based Research Information Management (RIM) service developed by the Information and Library Network (INFLIBNET) provides a great support and create the scholarly network in our country. The IRINS also provides greater exposure of research contributions to the international community and helps to collaborate with the interdisciplinary research activities.

In essence, IRINS could be used effectively by the IITs as on instrument to showcase their research output, expertise, skills, research experience, accomplishments, projects and other scholarly activity.

Review of Literature

The literature review is not comprehensive, but is rather limited to the areas in the context of IRINS analysis in various instances.

Tamizhchelvan and Anbalagan (2020) analyzed Gandhigram Rural Institute in the context of IRINS. The study analyzed the faculty members, department and their scholarly publications with citations and its impact. The result shows that the Department of Chemistry has highest publications and citations 742(34.13%) and 14306(57.15%) respectively. Four Department of Chemistry, two Mathematics and Physics occupied in the top ten faculty members.

Kimidi (2020) reported that the Research Information Management (RIM) system plays an important role in showcasing the research output of the academic and research institutions to the world. The research information from individual researchers to an institute can be made visible through an effective and efficient RIM system only. Further describes the growth and the penetration of the RIM concept across the country and its outreach by an indigenously built platform, the Indian Research Information Network System (IRINS).

Sab, Kumar, and Biradar (2019) provided an overview on IRINS. They analyzed 17 institutions including universities, R&D organizations and IITs using calculations with percentage and ranking.

Balasubramani, Anbalagan, and Palavesam (2019) analyzed the faculty members, department and their scholarly publications with citations and its impact of 15 academic and R&D organizations in India through IRINS. The finding shows that Koneru Lakshmaiah (KL) Deemed University, Guntur has the highest 836(17.22%) faculty members. The Indian Institute of Technology (IIT), Madras has received 278374(26.28%) highest Scopus citations and 227686(22.30%) Cross Reference citations.

Hasan (2018) provided a clear view of the information systems (IS) by quick and clear approach starting from the definition, dimension, infrastructure and the main types of information systems. The result shows that the management of IS plays a significant role in the success of an organization's performance through a set of procedures and functions.

Kannan, Kimidi and Arora (2018) in a study, elaborated that IRINS can be used as a common platform across all educational and research institutes in Indian higher education sector.

They articulated that the IRINS could be used effectively for efficiently measuring and benchmarking research output of individual institute as well as across the institutions.

Joachim, Hélène and Violane (2017) in a study provide an overview of recent research and publications on the integration of research data in Current Research Information Systems (CRIS). The study contributes to the debate on the evaluation of research data, especially in the environment of open science and open data, and helpful in implementing CRIS and research data policies.

Joint Nicholas (2008) provided an overview of larger developments in the international research information environment, and outlines their impact on the open access movement within libraries. The finding indicated that developments in the research landscape have important effects on grass-roots library and information science practice.

Research objectives

The main objective of the present study is to analyze the IRINS implemented Institutions of National Importance with special reference to twenty-three (23) Indian Institute of Technology (IIT) in India. The major objectives appended below:

- To analyze the scholarly resources of the IITs;
- To analyze the Scopus citations and CrossRef citations;
- To analyze the resource impact from scholarly resources;
- To analyze the contributions of top department of individual IITs and h-index.
- To analyze the top faculty of individual IITs and h-index.

Research methodology

The selection of an appropriate research methodology is highly crucial to any social investigation. To undertake the present study, data were collected from the Indian Research Information Network System (IRINS) instances in February, 2021 for conducting the empirical analysis. The present study confined to twenty-three (23) Indian Institute of Technology (IIT) in India declared as Institutions of National Importance, centrally funded by Government of India. The collected data were classified, analyzed and tabulated by using simple statistical methods.

Data Analysis and Interpretation

Demographic representation analysis

The IRINS gives a deep insight and picture of the institution's competency in the context of core faculty and the research strength. The IRINS has been completely spread across India with 151 active institutional IRINS instances and ranked in the first position in competing with European countries. The demographic representation of IRINS implemented Indian Institute of Technology (IIT) in India depicted in table-1 and top five IITs in table-1.1. On analysis, it has been found that 23 IITs hold total 6153 number of faculties and top 5 IITs hold the 51.17% of total faculties affiliated to IITs. Among 23 IITs, the IIT Bombay holds the highest number of faculties

763(12.40%) followed by IIT Kharagpur 689(11.19%), IIT Madras 629(10.23%), IIT Delhi 605(9.83%) and IIT Kanpur 463(7.52%). The IIT Goa holds the lowest number of faculties 45(0.73%) (Table 1-1.1).

Table 1. Demographic representation analysis

Sr. No.	Organization/Institute Name	Type of Organization/Institute	Number of Faculty	%	Rank
1.	Indian Institute of Technology (ISM), IIT, Dhanbad	Institute of National Importance (CFTI)	297	4.83%	8
2.	Indian Institute of Technology(IIT), Bhilai	Institute of National Importance (CFTI)	59	0.96%	21
3.	Indian Institute of Technology(IIT), BHU, Varanasi	Institute of National Importance (CFTI)	173	2.81%	10
4.	Indian Institute of Technology(IIT), Bhubaneswar	Institute of National Importance (CFTI)	171	2.78%	11
5.	Indian Institute of Technology(IIT), Bombay	Institute of National Importance (CFTI)	763	12.40%	1
6.	Indian Institute of Technology(IIT), Delhi	Institute of National Importance (CFTI)	605	9.83%	4
7.	Indian Institute of Technology(IIT), Dharwad	Institute of National Importance (CFTI)	55	0.89%	22
8.	Indian Institute of Technology(IIT), Gandhinagar	Institute of National Importance (CFTI)	134	2.18%	15
9.	Indian Institute of Technology(IIT), Goa	Institute of National Importance (CFTI)	45	0.73%	23
10.	Indian Institute of Technology(IIT), Guwahati	Institute of National Importance (CFTI)	422	6.86%	7
11.	Indian Institute of Technology(IIT), Hyderabad	Institute of National Importance (CFTI)	248	4.03%	9
12.	Indian Institute of Technology(IIT), Indore	Institute of National Importance (CFTI)	155	2.52%	14
13.	Indian Institute of Technology(IIT), Jammu	Institute of National Importance (CFTI)	67	1.09%	20
14.	Indian Institute of Technology(IIT), Jodhpur	Institute of National Importance (CFTI)	156	2.54%	13
15.	Indian Institute of Technology(IIT), Kanpur	Institute of National Importance (CFTI)	463	7.52%	5
16.	Indian Institute of Technology(IIT), Kharagpur	Institute of National Importance (CFTI)	689	11.19%	2
17.	Indian Institute of Technology(IIT), Madras	Institute of National Importance (CFTI)	629	10.23%	3
18.	Indian Institute of Technology(IIT), Mandi	Institute of National Importance (CFTI)	127	2.07%	16

19.	Indian Institute of Technology(IIT), Palakkad	Institute of National Importance (CFTI)	72	1.17%	19
20.	Indian Institute of Technology(IIT), Patna	Institute of National Importance (CFTI)	123	2.00%	17
21.	Indian Institute of Technology(IIT), Roorkee	Institute of National Importance (CFTI)	453	7.36%	6
22.	Indian Institute of Technology(IIT), Ropar	Institute of National Importance (CFTI)	165	2.68%	12
23.	Indian Institute of Technology(IIT), Tirupati	Institute of National Importance (CFTI)	82	1.33%	18
TOTAL			**6153**	**100%**	

***CFTI = Centrally Funded Technical Institutes**

Table 1.1. Ranking wise top 5 IITs in demographic representation analysis

Sr. No.	Organization/Institute Name	Type of Institute	Number of Faculty	%	Rank
1.	Indian Institute of Technology(IIT), Bombay	Institute of National Importance (CFTI)	763	12.40%	1
2.	Indian Institute of Technology(IIT), Kharagpur	Institute of National Importance (CFTI)	689	11.19%	2
3.	Indian Institute of Technology(IIT), Madras	Institute of National Importance (CFTI)	629	10.23%	3
4.	Indian Institute of Technology(IIT), Delhi	Institute of National Importance (CFTI)	605	9.83%	4
5.	Indian Institute of Technology(IIT), Kanpur	Institute of National Importance (CFTI)	463	7.52%	5
TOTAL			**3149 (51.17%) of total 6153 faculty members**		

Scholarly resources analysis

The IRINS portal facilitates the institutions to collect, curate, and showcase the scholarly publication activities of their core faculties and provides an opportunity to create a scholarly network among them. IRINS gives an overview of the publication category about the publication venues Open Access (OA) that enables the research community to easily understand and to get an overview of the publication category bound to the Gold, Green and Bronze OA (open access). Table-2 presents the analysis of scholarly resources of individual IRINS implemented IITs in India. On analysis, it has been found that 23 IITs have total 212333 scholarly resources and as depicted in table 2.1, the top 5 IITs hold the 63.56% of the total scholarly resources. The analysis shows that IIT Delhi has the highest scholarly resources 30817(14.51%) followed by IIT Kharagpur 28756(13.54%), IIT Madras 28587 (13.46%), IIT Bombay 27806(13.11%) and IIT Kanpur 18982(8.94%) (Table 2-2.1).

Table 2. Analysis of scholarly resources of IITs

Sr. No.	Organization/Institute Name	Total Scholarly Resources	%	Gold Open Access	Green Open Access	Bronze Open Access	Rank
1.	IIT, Dhanbad	9671	4.55%	561	132	272	8
2.	IIT, Bhilai	346	0.16%	13	31	01	20
3.	IIT, BHU, Varanasi	5936	2.80%	414	289	222	9
4.	IIT, Bhubaneswar	3467	1.63%	512	124	88	12
5.	IIT, Bombay	27806	13.11%	975	2227	643	4
6.	IIT, Delhi	30817	14.51%	1015	1375	731	1
7.	IIT, Dharwad	234	0.11%	06	16	08	22
8.	IIT, Gandhinagar	2331	1.09%	131	177	54	16
9.	IIT, Goa	199	0.09%	17	13	01	23
10.	IIT, Guwahati	15759	7.42%	862	1099	331	7
11.	IIT, Hyderabad	5805	2.73%	360	832	246	10
12.	IIT, Indore	5014	2.36%	410	399	64	11
13.	IIT, Jammu	277	0.13%	12	32	05	21
14.	IIT, Jodhpur	2052	0.97%	146	174	51	17
15.	IIT, Kanpur	18982	8.94%	784	1783	630	5
16.	IIT, Kharagpur	28756	13.54%	1043	1362	677	2
17.	IIT, Madras	28587	13.46%	1526	1643	906	3
18.	IIT, Mandi	2562	1.21%	158	233	52	15
19.	IIT, Palakkad	422	0.20%	20	20	13	18
20.	IIT, Patna	2708	1.28%	98	55	34	14
21.	IIT, Roorkee	17471	8.23%	769	512	408	6
22.	IIT, Ropar	2776	1.31%	121	254	33	13
23.	IIT, Tirupati	355	0.17%	14	18	04	19
TOTAL		**212333**	**100%**	**9967**	**12800**	**5474**	

Table 2.1. Ranking wise top 5 IITs in scholarly resources analysis

Sr. No.	Organization/Institute Name	Total Scholarly Resources	%	Gold Open Access	Green Open Access	Bronze Open Access	Rank
1.	IIT, Delhi	30817	14.51%	1015	1375	731	1
2.	IIT, Kharagpur	28756	13.54%	1043	1362	677	2
3.	IIT, Madras	28587	13.46%	1526	1643	906	3
4.	IIT, Bombay	27806	13.11%	975	2227	643	4
5.	IIT, Kanpur	18982	8.94%	784	1783	630	5
TOTAL		**134948 (63.56%) of total 212333 scholarly resources**					

Analysis of resource impact of scholarly resources

IRINS captures citations against each publication having a valid Digital Object Identifier (DOI). Table-3 gives a clear picture of the citations captured by the Scopus and Crossref. The analysis shows that IIT Kharagpur has the highest 444701 Scopus citations (average 15.76) and 380300

crossref citations (average 13.23) followed by IIT Delhi has 441671 Scopus citations (average 14.33), 368961 crossref citations (average 11.97), IIT Bombay has 441621 Scopus citations (average 15.88), 374884 crossref citations(average 13.48), IIT Madras has 421118 Scopus citations (average 16.46), 364212 crossref citations (average 12.74) and IIT Kanpur 262411 Scopus citations (average 13.82), 238263 crossref citations (average 12.55). Whereas, IIT Bhubaneshwar holds first rank in average ranking of Scopus citations with average 16.70 and IIT BHU, Varanasi in CrossRef citations with average 14.28 (Table 3-3.1).

Table 3. Analysis of resource impact of scholarly resources

Sr. No.	Organization/ Institute Name	Total Scholarly Resources	Scopus Citation			CrossRef Citation		
			Score	Average	Average Rank	Score	Average	Average Rank
1.	IIT, Dhanbad	9671 (4.55%)	71078	7.35	16	67862	7.02	16
2.	IIT, Bhilai	346 (0.16%)	1442	4.17	20	1356	3.92	19
3.	IIT, BHU, Varanasi	5936 (2.80%)	91870	15.48	5	84777	14.28	1
4.	IIT, Bhubaneswar	3467 (1.63%)	57916	16.70	1	47345	13.66	2
5.	IIT, Bombay	27806 (13.11%)	441621	15.88	3	374884	13.48	3
6.	IIT, Delhi	30817 (14.51%)	441671	14.33	6	368961	11.97	8
7.	IIT, Dharwad	234 (0.11%)	749	3.20	21	770	3.29	21
8.	IIT, Gandhinagar	2331 (1.09%)	19676	8.44	14	17367	7.45	14
9.	IIT, Goa	199 (0.09%)	605	3.04	22	682	3.43	20
10.	IIT, Guwahati	15759 (7.42%)	189693	12.04	11	170831	10.84	9
11.	IIT, Hyderabad	5805 (2.73%)	76324	13.15	8	70034	12.06	7
12.	IIT, Indore	5014 (2.36%)	62171	12.39	9	47476	9.47	12
13.	IIT, Jammu	277 (0.13%)	2480	8.95	13	2837	10.24	11
14.	IIT, Jodhpur	2052 (0.97%)	14856	7.24	17	14063	6.85	17
15.	IIT, Kanpur	18982 (8.94%)	262411	13.82	7	238263	12.55	6
16.	IIT, Kharagpur	28756 (13.54%)	444701	15.76	4	380300	13.23	4

17.	IIT, Madras	28587 (13.46%)	421118	16.46	2	364212	12.74	5
18.	IIT, Mandi	2562 (1.21%)	21551	8.41	15	18965	7.40	15
19.	IIT, Palakkad	422 (0.20%)	1802	4.27	19	1709	4.05	18
20.	IIT, Patna	2708 (1.28%)	15732	5.81	18	8037	2.97	22
21.	IIT, Roorkee	17471 (8.23%)	214708	12.29	10	180799	10.35	10
22.	IIT, Ropar	2776 (1.31%)	32108	11.57	12	24824	8.94	13
23.	IIT, Tirupati	355 (0.17%)	753	2.12	23	681	1.92	23
TOTAL		**212333 (100%)**	**2887036**			**2487035**		

Table 3.1. Top 5 IITs with Scopus citation ranking

Sr. No.	Organization/Institute Name	Total Scholarly Resources	Scopus Citation	CrossRef Citation	Rank
1.	IIT, Kharagpur	28756 (13.54%)	444701	380300	1
2.	IIT, Delhi	30817 (14.51%)	441671	368961	2
3.	IIT, Bombay	27806 (13.11%)	441621	374884	3
4.	IIT, Madras	28587 (13.46%)	421118	364212	4
5.	IIT, Kanpur	18982 (8.94%)	262411	238263	5

Types of scholarly resources analysis

IRINS provides a greater exposure of research contributions to the international community that helps to collaboration to interdisciplinary research activities. Table-4 shows the types of scholarly resources viz journal's articles, conference proceedings, books/chapters or other resources of IRINS implemented IITs in India. The analysis shows that IIT Kharagpur has the highest 21225(73.82%) journal article publications, IIT Bombay has the highest 7815(28.11%) conference/in-proceeding publications, IIT Delhi has the highest 690(2.24%) books/chapters publication with overall total scholarly publications also, and IIT Kanpur has the highest 2180(11.48%) other publications category (Table 4-4.1).

Table 4. Analysis of types of scholarly resources

Sr. No.	Organization/ Institute Name	Total Scholarly Resources	Rank	Types of Scholarly Resources							
				Journal Articles		Conference/ In Proceedings		Books / Chapters		Others	
				Score	%	Score	%	Score	%	Score	%

1.	IIT, Dhanbad	9671 (4.55%)	8	6961	71.98	2163	22.37	160	1.65	387	4.00
2.	IIT, Bhilai	346 (0.16%)	20	243	70.23	87	25.14	05	1.45	11	3.18
3.	IIT, BHU, Varanasi	5936 (2.80%)	9	4720	79.51	778	13.11	128	2.16	310	5.22
4.	IIT, Bhubaneswar	3467 (1.63%)	12	2622	75.63	641	18.49	85	2.45	119	3.43
5.	IIT, Bombay	27806 (13.11%)	4	18437	66.31	7815	28.11	465	1.67	1089	3.91
6.	IIT, Delhi	30817 (14.51%)	1	20899	67.82	7749	25.15	690	2.24	1479	4.79
7.	IIT, Dharwad	234 (0.11%)	22	130	55.55	93	39.75	01	0.43	10	4.27
8.	IIT, Gandhinagar	2331 (1.09%)	16	1548	66.41	558	23.94	90	3.86	135	5.79
9.	IIT, Goa	199 (0.09%)	23	136	68.34	55	27.64	02	1.01	06	3.01
10.	IIT, Guwahati	15759 (7.42%)	7	10828	68.71	3793	24.07	499	3.17	639	4.05
11.	IIT, Hyderabad	5805 (2.73%)	10	3901	67.21	1553	26.75	85	1.46	266	4.58
12.	IIT, Indore	5014 (2.36%)	11	3763	75.05	998	19.90	82	1.64	171	3.41
13.	IIT, Jammu	277 (0.13%)	21	152	54.87	63	22.74	33	11.92	29	10.47
14.	IIT, Jodhpur	2052 (0.97%)	17	1324	64.52	570	27.78	54	26.33	104	5.07
15.	IIT, Kanpur	18982 (8.94%)	5	12312	64.86	4091	21.56	399	2.10	2180	11.48
16.	IIT, Kharagpur	28756 (13.54%)	2	21225	73.82	5844	20.32	611	2.12	1076	3.74
17.	IIT, Madras	28587 (13.46%)	3	20107	70.33	7040	24.63	509	1.78	931	3.26
18.	IIT, Mandi	2562 (1.21%)	15	1690	65.97	711	27.75	61	2.38	100	3.90
19.	IIT, Palakkad	422 (0.20%)	18	255	60.43	145	34.36	09	2.13	13	3.08
20.	IIT, Patna	2708 (1.28%)	14	1608	59.37	969	35.78	44	1.63	87	3.21
21.	IIT, Roorkee	17471 (8.23%)	6	12703	72.71	3764	21.54	326	1.87	678	3.88
22.	IIT, Ropar	2776 (1.31%)	13	2001	72.08	584	21.04	74	2.67	117	4.21
23.	IIT, Tirupati	355 (0.17%)	19	220	61.97	95	26.76	22	6.20	18	5.07
TOTAL		**212333 (100%)**		**147785**		**50159**		**4434**		**9955**	

Table 4.1. Top 5 IITs with highest types of scholarly resources

Sr. No.	Organization / Institute Name	Total Scholarly Resources	Rank	Types of Scholarly Resources											
				Journal Articles			Conference/ In Proceedings			Books / Chapters			Others		
				Score	%	Rank	Score	%	Rank	Score	%	Rank	Score	%	Rank
1.	IIT, Delhi	30817 (14.51%)	1	20899	67.82	2	7749	25.15	2	690	2.24	1	1479	4.79	2
2.	IIT, Kharagpur	28756 (13.54%)	2	21225	73.82	1	5844	20.32	4	611	2.12	2	1076	3.74	4
3.	IIT, Madras	28587 (13.46%)	3	20107	70.33	3	7040	24.63	3	509	1.78	3	931	3.26	5
4.	IIT, Bombay	27806 (13.11%)	4	18437	66.31	4	7815	28.11	1	465	1.67	4	1089	3.91	3
5.	IIT, Kanpur	18982 (8.94%)	5	12312	64.86	5	4091	21.56	5	399	2.10	5	2180	11.48	1

Research contribution of top departments of IITs

The presence of IRINS in the institution, strengthen the departments through its vital activities by depicting growth from the overall institute research publications. Table-5 indicates the research contribution of top department of IRINS implemented IITs in India. The analysis shows that top departments of 23 IITs contributed 29850 scholarly publications with 703539 Scopus citations and 599025 crossref citations. The Department of Electrical Engineering, IIT Delhi has the highest 5778 scholarly resources (average 5.33) with 75888 Scopus citations (average 13.13) and 60567 crossref citations (average 10.48) followed by Department of Physics, IIT Madras 3824 scholarly resources (average 7.48) with 118629 Scopus citations (average 31.02) and 100060 crossref citations (average 26.16), Department of Chemistry, IIT Kanpur 2370 scholarly resources (average 8.01) with 66072 Scopus citations (average 27.87) and 57120 crossref citations (average 24.10), Mechanical and Industrial Engineering, IIT Roorkee 2365 resources (average 7.38) with 39108 Scopus citations (average 16.53) and 33910 crossref citations (average 14.33) and Department of Physics, IIT Bombay has 2351 scholarly resources (average 11.83) with 140702 Scopus citations (average 59.84) and 118632 crossref citations (average 50.46) (Table 5-5.1).

Table 5. Research contribution of top departments of IITs

Sr. No.	Top Departments of IITs	Scholarly Resources			Scopus Citation		CrossRef Citation		h-Index	Rank
		Score	Rank	Average	Score	Average	Score	Average		
1.	Department of Physics,	1106	10	8.74	11992	10.84	12273	11.09	43	14

	IIT Dhanbad									
2.	Department of Chemistry, IIT Bhilai	52	20	6.65	478	9.19	494	9.50	12	19
3.	Department of Chemistry, IIT Varanasi	998	11	5.95	26718	26.77	22119	22.16	79	8
4.	School of Basic Science, IIT, Bhubaneswar	1326	8	2.61	36061	27.19	27100	20.43	79	7
5.	Department of Physics, IIT, Bombay	2351	5	11.83	140702	59.84	118632	50.46	130	1
6.	Department of Electrical Engineering, IIT Delhi	5778	1	5.33	75888	13.13	60567	10.48	102	3
7.	Department of Biosciences and Bioengineering, IIT, Dharwad	25	22	9.36	385	15.40	461	18.44	8	23
8.	Department of Physics, IIT, Gandhinagar	160	17	14.56	4892	3.57	4265	26.65	32	16
9.	School of Mechanical Sciences, IIT, Goa	51	21	3.90	257	5.03	278	5.45	9	21
10.	Department of Chemistry, IIT, Guwahati	2207	7	7.14	43909	19.89	42233	19.13	83	6
11.	Department of Physics, IIT, Hyderabad	810	13	7.16	15763	19.46	15593	19.25	58	11
12.	Department of Physics, IIT, Indore	948	12	5.28	28842	30.42	23330	24.60	77	9
13.	Department of Physics, IIT, Jammu	24	23	11.54	1083	45.12	1328	55.33	12	20
14.	Department of Electrical Engineering, IIT, Jodhpur	559	15	3.67	4656	8.32	4330	7.74	34	15
15.	Department of Chemistry, IIT, Kanpur	2370	3	8.01	66072	27.87	57120	24.10	101	4
16.	Department of Chemistry, IIT, Kharagpur	2273	6	12.65	56554	24.88	48795	21.46	93	5
17.	Department of Physics, IIT, Madras	3824	2	7.48	118629	31.02	100060	26.16	120	2
18.	School of Basic Sciences, IIT, Mandi	1156	9	2.21	13663	11.81	12253	10.59	48	13
19.	Department of Mechanical Engineering, IIT, Palakkad	114	18	3.70	503	4.41	474	4.15	12	18
20.	Department of Mechanical Engineering, IIT, Patna	544	16	4.97	4004	7.36	2458	4.51	29	17
21.	Mechanical and Industrial Engineering, IIT, Roorkee	2365	4	7.38	39108	16.53	33910	14.33	66	10

22.	Department of Chemistry, IIT, Ropar	721	14	3.85	13116	18.19	10718	14.86	52	12
23.	Department of Civil and Environmental Engineering, IIT, Tirupati	88	19	4.03	264	3.00	234	2.65	9	22
TOTAL		**29850**			**703539**		**599025**			

Table 5.1. Top 5 departments of IITs with highest scholarly resources

Sr. No.	Top Departments of IITs	Scholarly Resources			Scopus Citation		CrossRef Citation		h-Index	Rank
		Score	Rank	Average	Score	Average	Score	Average		
1.	Department of Electrical Engineering, IIT Delhi	5778	1	5.33	75888	13.13	60567	10.48	102	3
2.	Department of Physics, IIT, Madras	3824	2	7.48	118629	31.02	100060	26.16	120	2
3.	Department of Chemistry, IIT, Kanpur	2370	3	8.01	66072	27.87	57120	24.10	101	4
4.	Mechanical and Industrial Engineering, IIT, Roorkee	2365	4	7.38	39108	16.53	33910	14.33	66	10
5.	Department of Physics, IIT, Bombay	2351	5	11.83	140702	59.84	118632	50.46	130	1

Highest h-Index of top 5 departments of IITs

Table-6 indicates the highest h-index of top 5 departments of IITs among the IRINS implemented 23 IITs. The analysis shows that the Department of Physics, IIT Bombay has the highest 130 h-index followed by Department of Physics, IIT Madras with 120 h-index, Department of Electrical Engineering, IIT Delhi with 102 h-index, Department of Chemistry, IIT Kanpur with 101 h-index and Department of Chemistry, IIT Kharagpur with 93 h-index (Table 6).

Table 6. Top 5 departments of IITs with highest h-index

Sr. No.	Top 5 Department of IITs	Scholarly Resources		Scopus Citation		CrossRef Citation		h-Index	Rank
		Score	Average	Score	Average	Score	Average		
1.	Department of Physics, IIT, Bombay	2351	11.83	140702	59.84	118632	50.46	130	1
2.	Department of Physics, IIT, Madras	3824	7.48	118629	31.02	100060	26.16	120	2
3.	Department of Electrical Engineering, IIT Delhi	5778	5.33	75888	13.13	60567	10.48	102	3

4.	Department of Chemistry, IIT, Kanpur	2370	8.01	66072	27.87	57120	24.10	101	4
5.	Department of Chemistry, IIT, Kharagpur	2273	12.65	56554	24.88	48795	21.46	93	5

Research contribution of top faculties of IITs

IRINS facilitate the faculties to showcase their research contributions to their peer groups and scholars and provide a greater exposure of their research contributions along with bibliometric parameters as publications, citations, h-index, etc. IRINS automatically process the updation of publications and citations through SCOPUS, CrossRef and ORCID ID.

Table-7 includes information on the scholarly resources, average citation value and h-index as found from IRINS instances. Prof. Bhim Singh, IIT Delhi has the highest scholarly resources 1898 (6.15%, average 16.23) with 26245 (average 13.82) Scopus citations, 19293 (average 10.16) crossref citations followed by Prof. Prafulla Kumar Behera, IIT Madras 1374 (4.80%, average 20.80) scholarly resources with 59841 (average 43.55) Scopus citations, 42640 (average 31.03) crossref citations, Dr. Seema Bahinipati, IIT Bhubaneswar 887 (25.58%, average 3.90) scholarly resources with 36913 (average 41.61) Scopus citations, 26239 (average 29.58) crossref citations, Prof. Bipul Bhuvan, IIT Guwahati 739 (4.68%, average 21.35) with 28373 (average 38.39) Scopus citations, 19676 (average 26.62) crossref citations and Dr. Anil Kumar, IIT Roorkee has 721 (4.12%, average 24.23) scholarly resources with 6326 Scopus citations (average 8.77), 5519 (average 7.65) crossref citations (Table 7-7.1).

Table 7. Research contribution of top faculties of IITs

Sr. No.	Top Faculties of IITs	Scholarly Resources	Rank	Average	Scopus Citation		Crossref Citation		h-Index	Rank
					Score	Average	Score	Average		
1.	Prof. Shishir Gupta, IIT Dhanbad	185 (1.91%)	20	52.27	1290	6.97	1002	5.41	21	21
2.	Prof. Santosh Biswas, IIT Bhilai	165 (47.68%)	21	2.09	1085	6.57	824	4.99	17	23
3.	Prof. Mumtaz Quraishi, IIT Banaras	351 (5.91%)	14	16.91	13794	39.29	8832	25.16	69	6
4.	Dr. Seema Bahinipati, IIT, Bhubaneswar	887 (25.58%)	3	3.90	36913	41.61	26239	29.58	82	4
5.	Dr. Basanta Kumar Nandi, IIT, Bombay	622 (2.23%)	6	44.70	50557	81.28	41450	66.63	113	1
6.	Prof. Bhim Singh, IIT, Delhi	1898 (6.15%)	1	16.23	26245	13.82	19293	10.16	68	7
7.	Prof. S R Mahadeva Prasanna, IIT,	354 (66.10%)	13	66.10	2014	5.68	1374	3.88	22	19

	Dharwad									
8.	Dr. Anand Sengupta, IIT, Gandhinagar	247 (10.54%)	18	9.43	11493	46.53	10975	44.43	56	8
9.	Prof. Dhirendra Bahadur, IIT, Goa	373 (53.35%)	12	53.35	9895	26.52	9274	24.86	52	9
10.	Prof. Bipul Bhuyan, IIT, Guwahati	739 (4.68%)	4	21.35	28373	38.39	19676	26.62	87	3
11.	Dr. Shantanu Desai, IIT, Hyderabad	402 (6.92%)	10	14.41	23788	59.17	22612	56.24	73	5
12.	Dr. Shaikh M. Mobin, IIT, Indore	465 (9.27%)	9	10.78	10460	22.49	8877	19.09	50	10
13.	Dr. Rahul Raghunath Salunkhe, IIT, Jammu	76 (27.43%)	23	3.64	7316	96.26	8363	110.03	43	15
14.	Dr. Surajit Ghosh, IIT, Jodhpur	304 (14.81%)	16	6.75	6997	23.01	6520	21.44	46	12
15.	Prof. Ashok Kumar, IIT, Kanpur	520 (2.73%)	7	36.50	9517	18.30	8452	16.25	46	13
16.	Dr. Suman Chakraborty, IIT, Kharagpur	508 (1.76%)	8	56.60	7915	15.58	7243	14.25	44	14
17.	Prof. Prafulla Kumar Behera, IIT, Madras	1374 (4.80%)	2	20.80	59841	43.55	42640	31.03	107	2
18.	Dr. Rahul Vaish, IIT, Mandi	239 (10.71%)	19	10.71	3149	13.17	2937	12.28	27	17
19.	Prof. Vinod Achutavarrier Prasad, IIT, Palakkad	349 (82.70%)	15	1.20	2387	6.83	1839	5.26	24	18
20.	Dr. Sriparna Saha, IIT, Patna	266 (9.82%)	17	1.58	2723	10.23	1844	6.93	21	20
21.	Dr. Anil Kumar, IIT, Roorkee	721 (4.12%)	5	24.23	6326	8.77	5519	7.65	34	16
22.	Prof. R P Chhabra, IIT, Ropar	375 (13.50%)	11	7.40	8851	23.60	6829	18.21	48	11
23.	Dr. P C Deshmukh, IIT, Tirupati	140 (39.43%)	22	2.53	1359	9.70	1173	8.37	20	22
TOTAL		**11560**			**332288**		**263787**			

Table 7.1. Top 5 faculties of IITs with highest research contribution

Sr. No.	Top 5 Faculties of IITs	Scholarly Resources	Rank	Average	Scopus Citation		Crossref Citation	
					Score	Average	Score	Average
1.	Prof. Bhim Singh, IIT, Delhi	1898 (6.15%)	1	16.23	26245	13.82	19293	10.16
2.	Prof. Prafulla Kumar Behera,	1374	2	20.80	59841	43.55	42640	31.03

	IIT, Madras	(4.80%)						
3.	Dr. Seema Bahinipati, IIT, Bhubaneswar	887 (25.58%)	3	3.90	36913	41.61	26239	29.58
4.	Prof. Bipul Bhuyan, IIT, Guwahati	739 (4.68%)	4	21.35	28373	38.39	19676	26.62
5.	Dr. Anil Kumar, IIT, Roorkee	721 (4.12%)	5	24.23	6326	8.77	5519	7.65

Highest h-Index of top 5 faculties of IIT

An individual's h-index considers the researcher's best-cited papers and the number of citations that they have received (i.e. an h-index of 10 indicates an author has 10 papers that have each been cited 10 times or more) (Hirsch JE., 2005).

Table-8 includes the highest h-index of top 5 faculties out of the total 6153 IIT's faculty members as found from IRINS instances. Dr. Basanta Kumar Nandi, IIT Bombay has received highest 113 h-index followed by Prof. Prafulla Kumar Behera, IIT Madras 107 h-index, Prof. Bipul Bhuyan, IIT Guwahati 87 h-index, Dr. Seema Bahinipati, IIT Bhubaneswar 82 h-index and Dr. Shantanu Desai, IIT Hyderabad received 73 h-index (Table 8).

Table 8. Highest h-Index of top faculties of IITs

Sr. No.	Top Faculty of Individual Institute	Scholarly Resources	Average	Scopus Citation		Crossref Citation		h-Index	Rank
				Score	Average	Score	Average		
1.	Dr. Basanta Kumar Nandi, IIT, Bombay	622 (2.23%)	44.70	50557	81.28	41450	66.63	113	1
2.	Prof. Prafulla Kumar Behera, IIT, Madras	1374 (4.80%)	20.80	59841	43.55	42640	31.03	107	2
3.	Prof. Bipul Bhuyan, IIT, Guwahati	739 (4.68%)	21.35	28373	38.39	19676	26.62	87	3
4.	Dr. Seema Bahinipati, IIT, Bhubaneswar	887 (25.58%)	3.90	36913	41.61	26239	29.58	82	4
5.	Dr. Shantanu Desai, IIT, Hyderabad	402 (6.92%)	14.41	23788	59.17	22612	56.24	73	5

Major findings

The major findings discovered from the analysis of IRINS instance with special reference to IITs as given below: -

- IITs under the study holds total 6153 number of faculties and top 5 IITs hold 51.17% of total faculties affiliated to IITs. Among 23 IITs, the IIT Bombay holds the highest number of faculties 763(12.40%).
- IITs have total 212333 scholarly resources and the top 5 IITs have the 63.56% of the total scholarly resources. IIT Delhi has the highest scholarly resources 30817(14.51%).

- IIT Kharagpur has the highest 444701 Scopus citations (average 15.76) and 380300 crossref citations (average 13.23).
- IIT Kharagpur has the highest 21225(73.82%) journal article publications, IIT Bombay has the highest 7815(28.11%) conference/in-proceeding publications, IIT Delhi has the highest 690(2.24%) books/chapters publication with overall total scholarly publications also, and IIT Kanpur has the highest 2180(11.48%) other publications category.
- Top departments of 23 IITs under the study contributed 29850 scholarly publications with 703539 Scopus citations and 599025 crossref citations. The Department of Electrical Engineering, IIT Delhi has the highest 5778 scholarly resources (average 5.33) with 75888 Scopus citations (average 13.13) and 60567 crossref citations (average 10.48).
- Department of Physics, IIT Bombay has the highest 130 h-index.
- Prof. Bhim Singh, IIT Delhi has the highest scholarly resources 1898 (6.15%, average 16.23) with 26245 (average 13.82) Scopus citations, 19293 (average 10.16) crossref citations.
- Dr. Basanta Kumar Nandi, IIT Bombay has received highest 113 h-index.

Conclusion

Post independence of India, the Indian Institute of Technology (IIT) designed with the necessary dynamism, flexibility and capacity to adapt expanding knowledge and changes in the socio-economic requirements of modern society. Now the research activities and its findings in all major subject areas of IITs have been made accessible publicly to the research community across the world through different channels. The IRINS connected 51929 experts from 277 instances with 929819 research related metadata across the country and has more than 10699959 citations. It has been found that 23 IITs hold total 6153 number of faculties.

The Indian Research Information Network System (IRINS) in India has made a tremendous impact to promote and bring more awareness towards the research information management system for the higher education system and its benefits. The IRINS is displaying the figures and metrics of IITs, academic institutions, R&D organizations and representing a deep insight and picture of institution's competency in respect of the core faculty and the research strength through its research collaboration across the world.

The IRINS has a strong presence in higher education system in India and expanding the service to the academic community outside the India. IRINS is being now crossing its boundaries through its active association and presentations at various international arenas such as the Scholarly Communication Institute (FSCI), etc. Implementation of IRINS in Indian higher educational institutions and R&D organization has made presence in CRIS systems across the globe.

Recommendation

Intervention of Ministry of Education, Government of India and the University Grants Commission (UGC) may require for full-fledged implementation across all the centrally funded academic institutions towards greater visibility to research output and impact in all major subject domains and subject expertise. Once IRINS implemented in all the institutions in India, a national level single multi-institutional search interface may be developed that enable to compare the research productivity of higher education institutions.

Areas for future research

Finding the right readership for this analysis has been a significant challenge. Most of library and information science (LIS) professionals are often unaware of the current practices and patterns of IRINS. Future research efforts might investigate or examine the IRINS practices to revealed potential trends. Furthermore, the merging of RIMS and IR functional categories warrants attention for future research.

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